

## CONSERVATION PRACTICE STANDARD

### COVER CROP

(Acre)

CODE 340

#### DEFINITION

Grasses, legumes, forbs, or other herbaceous plants established for seasonal cover and conservation purposes.

#### PURPOSE

Reduce erosion from wind and water

Increase soil organic matter

Manage excess nutrients in the soil profile

Promote biological nitrogen fixation

Increase biodiversity

Weed suppression

Provide supplemental forage

Soil moisture management

#### CONDITIONS WHERE PRACTICE APPLIES

On all lands requiring vegetative cover or increased biomass amounts or diversity for natural resource protection or improvement.

#### CRITERIA

##### General Criteria Applicable To All Purposes

Cover crop establishment, management and suppression requirements must be compatible with other crop, nutrient and pest management practices being used.

The species of cover crop selected and the time and method of planting must be compatible with herbicides used in previous crops to avoid carry-over residual activity that could kill or hinder establishment of the cover crop. Caution must be emphasized when applying lime on soil which has previously received atrazine. Lime can release atrazine and may cause a seeding failure.

Cover crops can be terminated by harvest, frost, mowing, tillage, herbicides, and/or other cultural practices. Cover crop residue will not be burned. Herbicides used to kill or suppress cover crops must be compatible with the following crop or plants.

##### Additional Criteria to Reduce Erosion From Wind and Water

Cover crop establishment, in conjunction with other practices, will be timed so that the soil will be adequately protected during the critical erosion period(s).

Plants selected for cover crops will have the physical characteristics necessary to provide adequate protection.

The amount of surface and/or canopy cover needed from the cover crop shall be determined using current erosion prediction technology.

##### Additional Criteria to Increase Soil Organic Matter

Cover crop species will be selected on the basis of producing large amounts (by weight) of organic matter to maintain or improve soil organic matter.

There should be a net increase in soil organic matter as a result of including the cover crop in the operation. Organic matter losses by tillage to establish or control the cover crop cannot exceed the organic matter gains from the cover crop. No-till establishment and control methods other than tillage are strongly recommended if organic matter increase is an objective. The NRCS Soil Conditioning Index (SCI) or equivalent procedure will be used to develop cover crop alternatives that increase soil organic matter levels compared to systems without cover crops.

The cover crop should be planted as early as possible and terminated as late as practical to maximize biomass production, and still have adequate time to establish following crop. Interseeding and/or aerial seeding may be needed where the main crop harvest is later than the recommended seeding dates for cover crops.

#### **Additional Criteria to Manage Excess Nutrients in the Soil Profile**

Cover crops should be established and actively growing before expected periods of high precipitation that can cause leaching.

Cover crop species will be selected for their ability to absorb large amounts of nutrients from the rooting profile of the soil. In general annual grasses with fibrous roots are best suited for removing large amounts of nutrients from the plow layer; taprooted broadleaf species are more effective at removing nutrients from deep in the rooting zone. For uptake of nutrients in fall applied manure, winter grains are the best cover crop.

When it is desirable to remove nutrients from a particular area, such as in fields adjacent to environmentally sensitive areas or buffer strips, the aboveground biomass should be removed from the field for maximum nutrient removal efficiency.

#### **Additional Criteria to Promote Biological Nitrogen Fixation**

Species-specific Rhizobia bacteria will either be present in the soil or the seed will be inoculated at the time of planting legumes.

Nitrogen credits from legume cover crops will be accounted for in the nutrient management plan.

The cover crop should be terminated as late as practical to maximize plant growth and nitrogen fixation, and still prepare the seedbed for the subsequent crop.

#### **Additional Criteria to Increase Biodiversity**

Cover crop species or mix of species should be selected that: have different maturity dates from other crops being grown, different growth or rooting traits, attract beneficial insects, serve as a trap crop for damaging insects, and/or provide food and cover for wildlife habitat management.

Cover crop species may be selected on the basis of producing large amounts of fibrous root mass to improve soil structure and aggregation, when the crop rotation does not provide this diversity.

#### **Additional Criteria for Weed Suppression**

Species for the cover crop will be selected for their chemical or physical competition with weeds. Favor cover crop species with either a high biomass potential, allelopathic effect, or both. (Allelopathy is the ability of some plants, to produce a chemical compound that can inhibit the ability of other plants to germinate or grow).

Cover crops residues will be left on the soil surface to maximize allelopathic (chemical) and mulching (physical) effects.

For long-term weed suppression, perennials and/or biennial species can be used.

Higher seeding rates and earlier seeding dates should be selected to develop denser stands of cover crop that are more effective in suppressing weeds.

Consider cover crop species that can be used in conjunction with selective herbicides to control targeted weed species.

#### **Additional Criteria to Provide Supplemental Forage**

Species selected will have desired forage traits, be palatable to livestock, and not interfere with the production of the subsequent crop.

Forage provided by the cover crop may be hayed or grazed as long as sufficient biomass is left to achieve other objectives.

Supplemental fertilizer may be needed if the cover crop is to be harvested.

When cover crop is grazed, at least four (4) inches of height and 50% canopy cover must be retained during the critical erosion period. If the subsequent crop requires a minimum amount of residue cover for erosion control, harvesting must be done in a way that leaves this much cover.

Extreme care must be taken to avoid soil compaction if cover crop is grazed.

#### **Additional Criteria for Soil Moisture Management**

Terminate growth of the cover crop sufficiently early (2 – 3 weeks before planting) to conserve soil moisture for the subsequent crop.

In areas of potential excess soil moisture, allow the cover crop to grow as long as possible to optimize soil moisture removal.

Cover crops established for moisture conservation during the growing season shall be left on the soil surface to provide mulch for the subsequent crop.

### **CONSIDERATIONS**

Soil fertility requirements for cover crop vary greatly depending on species selected and planned purposes for the cover crop. Most annual cover crops do not require fertilization. Non-legume cover crops may benefit from additional nitrogen if levels are suspected to be low or marginal, or if cover crop will be harvested for forage. Perennial cover crops in orchards, nurseries and vineyards should receive lime and fertilizer according to soil test recommendations. In general, most purposes are best achieved with an optimum soil fertility level as determined by soil test and Penn State Cooperative Extension recommendations.

Cover crops planted to provide supplemental ground cover after poor cropping years, due to cold or dry weather, have an increased likelihood of suffering from herbicide carry-over residual activity that can kill or suppress late summer or fall seeded cover crops. Soil assay procedures may be needed if there is a high likelihood of unusual herbicide residual carry-over activity.

Cover crops may be primary or secondary hosts for pests of subsequent or adjacent crops. Avoid cover crop species that attract potentially damaging insects. Use of cover crops to provide habitat for beneficial insects is not well known in Pennsylvania. Consult References listed in this standard for more information.

In cropping rotations where crop residues provide adequate ground cover for erosion control, cover crops may still provide a benefit to soil quality from diversity provided by fibrous root mass.

In orchards or vineyards select species that will be minimally competitive to fruit production plants for water and nutrients.

The Purposes and benefits of cover crops are best preserved by not using tillage as part of the control or termination method.

No-till seeding of cover crops is the preferred method of establishment. Elimination of tillage operations reduces erosion and reduces time required for the establishment; because moisture is conserved establishment is generally more successful.

### **Additional Considerations to Improve Soil Quality**

To maximize soil quality improvement using cover crops, regular or annual use of cover crops as an integral part of the crop and soil management plan should be considered. Crop rotation planning must be done to provide windows of opportunity to establish and manage the cover crop, along with other management activities such as manure application, seedbed preparation, and pest and disease control.

Soil organic matter test levels may not show positive impacts from cover crops for 3 to 5 years, depending on amount of additional biomass produced per year by the cover crop and any additional tillage operations being used to establish or manage the cover crop.

The Soil Quality Test Kit Guide can be used to help evaluate soil structure and soil aggregation.

### **PLANS AND SPECIFICATIONS**

Specifications for establishment and maintenance shall be prepared for each field or treatment unit according to the criteria described in this standard. Or, specifications can be prepared based on a common management system being used on more than one field or management unit (such as

use of winter rye following corn silage, whenever corn is harvested for silage). Specifications should include recommended species, seeding rates and dates, establishment methods, nutrients (if needed), and other establishment and management information. Specifications can be recorded in narrative format or on job sheets or other appropriate forms. Table 1 lists recommended cover crop alternatives.

### **OPERATION AND MAINTENANCE**

Control weeds in the cover crop by mowing, grazing or selective herbicide application.

Unless self-seeding of the cover crop is desired, prevent the cover crop from producing viable seed by mowing, cutting for hay or silage, grazing, or applying selective herbicides. Do not harvest below a four (4) inch stubble height.

The cover crop should be controlled at least two (2) weeks prior to the normal planting date of the next crop. Delayed planting of spring crops is not recommended.

For living cover crops, select burndown and residual programs that suppress growth during crop emergence and early growth stages but that allows a minimum 50% surface cover during critical erosion periods.

Perennial covers in orchards and vineyards should be mowed at least twice a year. Maintain a non-vegetative strip one to two feet wide on each side of the trees.

### **REFERENCES**

[Agronomy Guide](http://AgGuide.agronomy.psu.edu) (current edition), Penn State College of Agricultural Sciences, Cooperative Extension, 112 Agricultural Administration Building, University Park, PA 16802. (814) 865-6713.  
<http://AgGuide.agronomy.psu.edu>

Controlling Weeds in Nursery and Landscape Plantings. 1997. Penn State College of Agricultural Sciences, Cooperative Extension, 112 Agricultural Administration Building, University Park, PA 16802. (814) 865-6713.

<http://pubs.cas.psu.edu/FreePubs/pdfs/uj236.pdf>

Erosion Control and Conservation Plantings on Non-Cropland. 1997. Penn State College of Agricultural Sciences, Cooperative Extension, 112 Agricultural Administration Building, University Park, PA 16802. (814) 865-6713

<http://pubs.cas.psu.edu/FreePubs/pdfs/uc150.pdf>

Managing Cover Crops Profitably, Second Edition (1998) Sustainable Agriculture Network, Sustainable Agriculture Publications, Hills Building, Room 10, University of Vermont, Burlington VT 05405-0082

<http://www.sare.org/mccp2/>

(The first edition is available on-line at

<http://www.sare.org/htdocs/mccp>)

Cover Crops for Conservation Tillage Systems, 1996, Penn State College of Agricultural Sciences, Cooperative Extension, 112 Agricultural Administration Building, University Park, PA 16802. (814) 865-6713

<http://pubs.cas.psu.edu/FreePubs/uc128.html>

Soil Quality Test Kit Guide, USDA Natural Resources Conservation Service, Soil Quality Institute.

<http://www.statlab.iastate.edu/survey/SQI/>

Soil Conditioning Index (current version), USDA Natural Resources Conservation Service, National Soil Survey Center, <ftp.nssc.nrcs.usda.gov/pub/lightle/scifiles>

USDA Natural Resources Conservation Service PLANTS Database.

<http://plants.usda.gov>

Plant Hardiness Zone Map. Henry M. Cathey, Miscellaneous Publication 1475, USDA Agricultural Research Service

Overview of Cover Crops and Green Manures, ATTRA, POB 3657, Fayetteville, AR 72702, 1-800-346-9140.

<http://www.attra.org/attra-pub/covercrop.html>

Farmscaping to Enhance Biological Control ATTRA, POB 3657, Fayetteville, AR 72702, 1-800-346-9140.

<http://www.attra.org/attra-pub/farmscape.html>

Vegetative Practice Design Application (VegSpec), USDA Natural Resources Conservation Service

<http://ironwood.itc.nrcs.usda.gov/Netdynamics/Vegspec/pages/HomeVegspec.htm>

**TABLE 1. RECOMMENDED COVER CROPS**

This is not a comprehensive listing of cover crop alternatives. The listed choices have broad adaptability and availability. Other species or mixes may be available that also meet user objectives and criteria of this standard.

<b>GRASSES</b>						
<b>Species</b>	<b>Normal Life Cycle</b>	<b>PLANT HARDINESS ZONE</b>	<b>Seeding Dates</b>	<b>SEEDING RATES</b>	<b>Biomass as cover crop</b>	<b>Comments</b>
Fescue, (fine fescues: creeping red, hard, sheep, Chewings)	Perennial	4	March 1- June 1  August 1- Sept. 15	10 lbs./ac.	Not intended as biomass producing cover crop.	Use as a living mulch in nurseries, orchards, vineyards, or similar perennial crops. Slower growing and shorter than orchardgrass, tall fescue.
Fescue, Tall <i>Festuca arundinacea</i>	Perennial	4	March 1- June 1  August 1- Sept. 15	8-15 lbs./ac.	Not intended as biomass producing cover crop.	Use as a living mulch in nurseries, orchards, vineyards, or similar perennial crops. Faster growing and taller than the fine fescues.
Millet, Japanese or foxtail	Annual	N/A	May 1- August 1	20-35 lbs./ac.	Not Available	Use as a summer annual cover crop to smother weeds and produce biomass.
Oats <b>AVENA SATIVA</b>	Annual	8	Feb. 1-March 15; or Fall before Sept. 15	2-3 bu./ac. (60-100 lbs./ac.)	2,000-4,000 lbs./ac.	Use as a summer annual or as a fall cover crop that winter kills and eliminates need for control the following spring. For fall use, plant at least 40-60 days before killing frost to provide cover. Allelopathic.
Orchardgrass <i>Dactylis glomerata</i>	Perennial	4	Aug.15-Sept. 30	8-15 lbs./ac.	Not intended as biomass producing cover crop.	Use as a living mulch in nurseries, orchards, vineyards, or similar perennial crops. Faster growing and taller than fine fescues.

GRASSES						
Species	Normal Life Cycle	PLANT HARDINESS ZONE	Seeding Dates	SEEDING RATES	Biomass as cover crop	Comments
Sorghum-Sudangrass Hybrids	Summer Annual	N/A	May 1-August 1	30-50 lbs./ac.	4,000-10,000 lbs./ac.	Used as a summer annual. Can produce large amounts of biomass. Tolerant to common corn herbicides. Requires good fertility for best growth. Allelopathic.
Rye <b>SECALE CEREALE</b>	Winter Annual	3	Aug. 1-Nov. 1	1-3 bu./ac. (60-200 lbs./ac.)	3,000-4,000 lbs./ac.	Commonly used annual cover crop for fall establishment. More herbicide tolerance than wheat. Produces much biomass and root mass if allowed to grow. Allelopathic.
Ryegrass, Annual <b>LOLIUM MULTIFLORUM</b>	Winter Annual	6	Spring through Fall, to Oct. 10	15-40 lbs./ac.	2,000-4,000 lbs./ac.	Can reseed itself early in spring if allowed to mature. Also used as summer annual in agricultural and non-ag applications.
Ryegrass, Perennial <i>Lolium</i> sp.	Perennial	4	Spring or Fall Aug. 1-Oct. 10	15-40 lbs./ac.	Not intended as biomass producing cover crop.	Use as a living mulch in nurseries, orchards, vineyards, or similar perennial crops. Faster growing than some of the fine fescue alternatives, but not as tall as orchardgrass or tall fescue.
Wheat, Winter <b>TRITICUM AESTIVUM</b>	Winter Annual	4	After Hessian fly-free date; usually after Sept. 30, to Oct. 20	120 lbs./ac. (90-150 lbs./ac.)	3,000-4,000 lbs./ac.	Used as a substitute for cereal rye when wheat is cheaper than rye. Not as vigorous as rye and produces less biomass. Seeding rates should be increased if planted late.

LEGUMES							
Species	Normal Life Cycle	PLANT HARDINESS ZONE	Seeding Dates	SEEDING RATES	Biomass as cover crop	Potential to Fix Nitrogen	Comments
Clover, Red <b>TRIFOLIUM PRATENSE</b>	Biennial/ Short Lived Perennial	4	March 1-May 15; Aug. 1-Sept. 1	7-18 lbs./ac.	2,000-4,000 lbs./ac.	100-110 lbs./ac.	Can be planted as a dormant seeding in wheat in late winter/early spring. Adapted to pH range of 6 to 7.5.
Clover, White <b>TRIFOLIUM REPENS</b>	Perennial	4	March 1-June 1; Aug. 1-Sept. 1	6-14 lbs./ac.	Not available.	100-130 lbs./ac.	Can be used with perennial grasses in perennial cover crop mixes.
Crownvetch <b>CORONILLA VARIA</b>	Perennial	4	March 1-June 1	5-20 lbs./ac.	Not available.		Use as a perennial living mulch that is chemically suppressed but not killed, prior to establishing the crop.
Sweetclover, yellow or white <i>Melilotus</i> sp.	Biennial	4	March 1-June 1	8-10 lbs./ac	3,000-5,000 lbs./ac.	Good	Taprooted plant, with growth coming from crown. Allelopathic. Adapted to pH range of 5 to 8.
Trefoil, Birdsfoot <b>LOTUS CORNICULATUS</b>	Perennial	4	March 1-June 1	5-10 lbs./ac.	Not available.		Use as a perennial living mulch that is chemically suppressed but not killed, prior to establishing the crop.
Vetch, Hairy <b>VISA VILLOSA</b>	Winter Annual	4	July 1-Sept. 1	15-40 lbs./ac.	2,300-4,000 lbs./ac.	80-250 lbs./ac.	Must be seeded with vetch-specific inoculum in early fall. Can become a weed in winter grain. Most nitrogen fixed by vetch will be done in the spring; must be managed accordingly. Can be seeded with rye if seeded early

						enough.
<b>OTHER PLANTS</b>						
<b>Species</b>	<b>Normal Life Cycle</b>	<b>PLANT HARDINESS ZONE</b>	<b>Seeding Dates</b>	<b>SEEDING RATES</b>	<b>Biomass as cover crop</b>	<b>Comments</b>
Buckwheat <i>Fagopyrum esculentum</i>	Annual	N/A	Spring or Fall	45 lbs./ac. (34-134 lbs./ac.)	2,000-3,000 lbs./ac.	Primary use is as a quick growing smother crop and soil conditioner.

See References for more information on recommended varieties.

Plant Hardiness Zone indicates the coldest climatic zone where winter survival can be expected. Species that do not survive winter can sometimes be planted as summer annuals. In plant hardiness zones with longer growing seasons, spring planting should be done early in the recommended range; fall planting can be done later in the recommended fall range of dates.

Use lower seeding rates when:

- erosion is not a serious problem;
- a good seedbed is prepared (e.g. no-till drill is used);
- existing crop residues are good;
- seeding at an optimum time of the year.

Use higher seeding rates when:

- erosion is a serious problem, especially on disturbed or construction sites;
- using planting methods that do not incorporate seeds (e.g. aerial or broadcast seeding);
- thicker cover is needed for forage, biomass production, or weed suppression;
- making very early or late seedings;
- an objective is to maximize nutrient uptake.

No seedbed preparation is needed for aerial, no-till, dormant or frost seeding. Otherwise, prepare a seedbed that allows seed to be placed 1/4 to 1/2 inch deep, up to 1 1/2 inch deep for larger seeded species. Tillage should be limited to the minimum amount necessary to get seed in the ground.

Amount of N available following legumes varies according to maturity of cover crop when killed, biomass amount, and whether cover crop is incorporated or not.

## SPECIFICATIONS

### COVER CROP

Specifications for establishment and maintenance shall be prepared for each field or treatment unit according to the criteria described in this standard. Items to be included include purpose(s) of the cover crop, crop to be followed (where applicable), recommended cover crop species or mix, seeding rates and dates, establishment methods, nutrients needed, and other establishment and management information. Specifications can be recorded in narrative format, on job sheets, or forms designed to provide specific requirements for the practice.

Crop or Application	Cover Crop Species (variety) Or Mix	Seeding Dates	Seeding Rate	Seeding Method	Comments

Seedbed Preparation: No preparation is needed for aerial, no-till, dormant or frost seeding. Otherwise, prepare a seedbed that allows seed to be placed 1/4 to 1/2 inch deep, up to 1 1/2 inch deep for larger seeded species. Tillage should be limited to the minimum amount necessary to get seed in the ground.

Soil Fertility: Soil fertility requirements vary greatly depending on species selected and planned purposes for the cover crop. Most annual cover crops do not require fertilization. Non-legume cover crops may benefit from additional nitrogen if levels are suspected to be low or marginal, or if cover crop will be harvested for forage. Perennial cover crops in orchards, nurseries and vineyards should be receive lime and fertilizer according to soil test recommendations. In general, most purposes are best achieved with an optimum soil fertility level as determined by soil test and Penn State Cooperative Extension recommendations.